

Dear Sirs,

You've asked about unlicensed data operations in rural communities. Thank you for taking the time to read my thoughts.

First we have to determine what rural is. As the WISPCON (<http://www.wispcon.info> Wireless Internet Service Provider Conference) first ever Consultant of the Year, I've worked with hundreds of wisps (Wireless Internet Service Providers) around the country. One of the few things that seem to be pretty consistent is that many of them think they are rural. With 10,000 people in the entire county, Odessa Washington is rural.

Seems like every couple of weeks I get a call from someone in a "rural" area who wants to become a wisp. I always ask "How many people live/work within a 15 mile radius (max useful range achievable using today's more common wireless data multipoint systems) of your preferred "broadcast location". Nearly 50% say something like "Oh, 15 MILES??? Um, 250,000 or so I guess." Sigh.... The Suburbs of Dallas do NOT count as rural, even if they are 20 miles away from down town!!!!!! Out here we have to drive twice that far to even get to a stop light!

For the purposes of defining WISP type rural applications I like to look at the scalability of the more common gear that's available. With 802.11b (Wi-Fi) gear we have 3 non overlapping channels and a practical limit of about 100 users per access point (AP, AU or Base Station - depending on the manufacturer). So with what is arguably the most common (and I would say the absolute worst protocol) gear used by the wisp market we have a maximum easy to build coverage of 300 customers. (Yes I know there are a lot of ways to cheat that number but it's too hard to teach so I don't teach it at this time.... Too many of those that try end up with unstable systems and have to move to alternate technologies anyway.)

With a potential 300 customer cell (assuming the 25% adoption rate that I've got at my own WISP over the last 3 years) and a cell size of 15 miles we've now maxed out the usefulness of the available 2.4 gig spectrum. This includes ALL competitors by the way. Access points will interfere with other access points in the area (not always fatal but certainly something that can/does affect service levels) so we're often limited to a practical (not academic) limit of 3 Wi-Fi transmit sites per cell.

When designing systems for people (as a WISP many up and coming WISPs come to me for startup help) I use the 300 \*likely\* customer base limit as a guide between rural and non rural systems. So, using my best engineering practices of the day, a rural market will have about 25% of it's households and businesses equal or less than 300. If there is cable/dsl in a market we can (for WISP purposes) fudge that somewhat. I'm starting to GAIN customers that started with the local DSL option as their contracts run out (I have no long term contracts, people can leave my service at any time but I've lost NO up and running customers to DSL, my Wireless DSL is faster, cheaper and more reliable) so I'm starting to wonder if it's a good idea to fudge the number by much.

For this discussion I think that a rural market should be one with less than 5000 people living/working in a 15 mile radius. In areas with such low population density I think that several orders of magnitude more signal should be allowed. It would be nice to be able to build 30 mile cells rather than 15 mile ones. (It takes 6 more dB is all, to go from 15 miles to 30. Toss in 6 more dB of fade margin to deal with dust storms, smoke from fires, and all of the other environmental factors that are not supposed to have an affect on this,

and 48 dB would work just fine. That would be a 10 db antenna with a 36dB transmitter (to get the numbers close). There are 4 watt amplifiers (I know that you guys don't like amps but I know people have used these and NOT caused harmful interference) out there today and there are radios that put out 30dB so getting to the higher output levels won't be hard.

I've tested my system (about 34 dB at the WPOP (Wireless Point of Presence) and 51dB at the remote) out to 32 miles and only fudged the rules by a couple of dB (at 2.4 the three for one radio gain to antenna gain) comes into play. I was able to make a link and pass data but it was sloooow and very unstable. I also had to drop down to older 2 meg 802.11 gear as the newer 802.11b stuff wouldn't work. It was fun to try though!

It's interesting to note that many rural areas are already higher in 2.4 GHz levels than their more urban counterparts. Many cell phone companies, utility companies, schools, hospitals etc. have been using a LOT of very high end, high powered PTP (point to point) links for many years now. They often use products like the Western Multiplex (now <http://www.proxim.com>) Lynx or Tsunami lines. These are radios that chew up fully HALF of the available spectrum per link. They are also FDD (frequency division duplex) so once you turn them on they begin transmitting on a very wide channel. Then they receive on another channel (transmitted by the other end). This makes for some very stable very low latency links. It also makes for a technology that really harms Wi-Fi (actually all 802.11 based systems) gear. You see, under the 802.11 protocols (this applies to all 802.11 that's widely in use today) the radios must first listen for a clear channel. If the airwaves are NOT in use they will transmit. If they are in use the radios will hold off and try again later. If the WISP is unlucky enough to do what I did they'll be in for a long and frustrating process of getting that WPOP working. What did I do? I placed my antenna 1 mile or so from the end of a 30 mile long AT&T backhaul link. It locked my system completely up. I had to physically move the system almost a mile sideways to get out of line a bit more with that link.

I half-way think that people that own spectrum shouldn't be allowed to use unlicensed space. They should at least be STRONGLY encouraged to use something else ;-).

I've now been knocked off-line 3 times. All of them from cell phone companies or utility companies running that type of gear and all from 10s of miles away. It's been very nice to see the level of cooperation that I've gotten from them all though. Once I find the source of the problem the issues have been resolved in a timely manner. In one case we found a radio that was transmitting at too high of a power level and needed to be replaced. In another case a company installed a new set of radios and just turned the power up all the way, thinking no one else was around (sigh....). In the third case a cell phone company replaced a pair of dead 2 gig radios with 2.4 gig ones. They got the 2 gig ones fixed and replaced ahead of schedule to free up the spectrum again.

It sure is nice to know that there are others out there that will play by "gentleman's rules".

When I brought a crew into the FCC offices last June to do a training session for the staff on exactly what a WISP is and what we do, we were able to document the existence of 2000 WISPs nation wide. Our estimate was that the true number was closer to 4000. Today the estimate is said to be around 8000. I still think it's closer to 4000, maybe 5000. It's hard to say because there are so many out there that simply take a dsl/cable link and extend it to family and

friends that are outside of the broadband cloud. They may service from 20 to 50 people. I think the average wisp has somewhere between 100 and 200 customers. There are getting to be quite a few that have more than 1000 though. Not bad for an industry that really only got started in the last 18 to 24 months and has had almost no help from any funding sources.

I, like most WISPs, have built out with cash on hand and bank loans. I'm about to put up my 10th broadcast site. I'll cover close to 2300 square MILES with fixed, nomadic AND mobile services. Taking terrain into account the actual coverage is likely going to be closer to 1,800 to 2,000 square miles. I have broadband access into towns as small as 250 people.

We also have broadband access in some cop cars. They get speeds of about 1 meg and can use email, web, chat etc. services while moving at 100mph (yeppers we tested that in the first car ;- ) and more. They can be up to 15 miles from my tower locations and as long as they have good line of site they can still get service, speeds drop to 256k or so though. The city department here just installed the system in both of their cars. They will be running a VPN (virtual private network, encrypted link running over public transport) from the cars back to the office and to the county servers. They'll be able to sit in the car (watching for people that drive like I do) and type reports, check driver's licenses, look up warrants, send and rec. email and voice conversations via a medium that will NOT set off the scanners that all of the bad guys carry. When funding allows we'll be able to place IP based cameras in high crime areas (out here the bad guys rob farm shops, get all the junk out and then come back in a few months to take all the nice new tools) and allow the dispatcher AND the officer in the field to actually WATCH what's going on before even showing up on scene. The safety issue for the officers and deputies is pretty significant. We had one case out here where a neighboring county had a convict escape. They were able to send not just a description or fuzzy black and white fax to our officers. They were able to email a MUG SHOT in full color right into the CARS!!!!!!

This same thing could easily be done in the local ambulances. They would have the ability to have a specialist see and hear what's happening with that patient in real time as the transport was taking place. With heart attack and stroke victims it's important for certain medications to be administered as quickly as possible to help prevent permanent injury. Our volunteer staff is not allowed to do things like that though. But if they were under the direct supervision of the best doctors in the world.....

I could go on and on about the people able to run businesses out of their houses now. How the farmers are starting to market their crops directly to the consumers, bypassing the commodities cartels. The massive amount of information that our school kids are able to access for their reports and research projects. Online degree programs, advanced degrees that the teachers are able to take right from home.

The amazing part of all this to me (besides the fact that it even works...) is the costs involved. The next county over (Grant County Wa.) is excited that they are eventually going to get their fiber to the home project down to \$2,200 or so per subscriber for the hook up costs. Using the top of the line wireless gear that's available today we can do this for \$1000 or so. Using the gear that I'm using my cost per customer is around \$500. This includes the customer end gear!!!! And the price per megabyte of deliverable data are dropping fast.

To really be able to service the masses today (especially in the more urban markets) we need more spectrum. Not just a few mhz here and there. We need hundreds of mhz and 10s of non overlapping channel plans. This will solve the scalability AND spectrum congestion issues. It would also be helpful if all radios had the ability to use gps timing so that all access points would transmit at the same time. This seems to help with scalability issues in the 5 gig bands right now. Channel reuse is much better due to the primary interfering devices (the ap's) being in the tx mode all at the same time across ALL radios world wide. Interference from client side radios is not nearly as much of a problem due to the more directionality of the average antennas used and the typically lower altitude.

It would also be nice to see some form of maximum spectrum per channel rule applied so that one company doesn't try to build a radio with 6 or more overlapping channels only to have another company build a product with 2 or three that's more interference robust but far less spectrally efficient. A very fine line must be walked though. It's kind of the wild wild west out here right now, but the Darwinian evolution of the products and the market place have served the end user VERY well compared to any other distribution schemes in use today.

Sincerely,  
Marlon K. Schafer  
(509) 982-2181